Encephalitis (Arboviral)

Report Immediately

Note: This chapter focuses on the arboviral infectious encephalitides (the types transmitted by insects). For information about non-arboviral encephalitis, refer to the chapter entitled "Encephalitis (Non-Arboviral)."

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

There are about 570 viruses worldwide that are spread through arthropods (insects). More than 30 of these arboviruses have been identified as human pathogens in the Western Hemisphere. In Massachusetts, two mosquito-borne arboviruses that cause encephalitis in humans have been identified: Eastern Equine Encephalitis (EEE) and West Nile virus (WNV). EEE is a member of the family *Togaviridae*, genus *Alphavirus*. WNV, a member of the *Flaviviridae* family and *Flavivirus* genus, has recently appeared in the Northeast. California encephalitis and St. Louis encephalitis (SLE) have been reported in New York and Connecticut, and Jamestown Canyon virus has been isolated from mosquitoes in New England.

Other important arboviral encephalitides in the Americas include Powassan encephalitis, Venezuelan equine encephalitis (VEE), Western equine encephalitis (WEE), LaCrosse encephalitis, Tensaw encephalitis, Everglades encephalitis, Ilheus encephalitis, and snowshoe hare encephalitis.

B. Clinical Description

Encephalitis is an inflammation of the brain. Arboviral infection may result in an acute febrile illness of variable severity and rate of progression associated with neurologic symptoms ranging from headache to aseptic meningitis (inflammation of the linings of the brain and spinal cord) to encephalitis. Many arboviral infections are asymptomatic. Arboviral encephalitis cannot be distinguished clinically from many other causes of encephalitis. Manifestations can include headache, confusion, lethargy, nausea, altered consciousness, vomiting, fever, cranial nerve palsies, paresis (muscular weakness) or paralysis, sensory deficits, altered reflexes, tremors, convulsions, abnormal movements, coma of varying degree, and, in some cases, death. Case-fatality rates range from less than 1% to 60%.

The first symptoms of EEE generally include a sudden onset of high fever, stiff neck, headache of increasing severity, lack of energy and general muscle pain. EEE is a serious neurologic infection and can lead rapidly to seizures, coma and death. As many as one-third of EEE cases are fatal.

With WNV infections, mild infections are common and include fever, headache, and body aches, often with a skin rash and swollen lymph glands. More severe infections are often associated with high fever, neck stiffness, stupor, disorientation, coma, tremors, occasional convulsions, paralysis, and rarely, death. Case-fatality rates for WNV range from 3% to15% of cases with clinical encephalitis. The other arboviral encephalitides produce similar clinical pictures, varying in severity from the relatively milder WNV infection to the more severe EEE.

C. Reservoirs

Reservoirs for many of the arboviral encephalitides are not known. Both EEE and WNV are carried by birds. The virus usually stays in birds and the mosquitoes that feed on them. Rarely, other kinds of mosquitoes that also bite people and horses pick up the viruses. Humans and horses are generally considered dead-end hosts.

The vectors for California encephalitis, LaCrosse encephalitis, snowshoe hare encephalitis, and Jamestown Canyon virus are *Aedes* mosquitoes. The vector for Powassan encephalitis virus is the *Ixodes cookei* tick, and

the reservoir is rodents, other small mammals and birds. VEE is maintained in a rodent-mosquito cycle; horses are also an important reservoir during outbreaks of VEE.

D. Modes of Transmission

EEE, Ilheus encephalitis, snowshoe hare encephalitis, SLE, California encephalitis, Jamestown Canyon virus, WEE, LaCrosse encephalitis, VEE, Tensaw encephalitis, Everglades encephalitis, and WNV are spread to humans by the bite of an infected mosquito. Powassan encephalitis is spread to humans by the bite of an infected tick (*Ixodes cookei*). Direct person-to-person spread of arboviral encephalitis does not occur.

There is no evidence that a person can get EEE or WNV from handling most live or dead infected birds or horses. However, EEE is known to be spread from bird-to-bird in flocks of rattites (emus, ostriches, and rheas). Rattites are large, flightless birds from Australia, Africa, and South America that are sometimes raised in the Northeast as livestock or zoo animals. In these birds, EEE causes a syndrome characterized by gastroenteritis and hemorrhage, and blood excreted in feces or secreted from other orifices is considered to contain large quantities of virus. Therefore, strict precautions should be taken when handling sick or dying rattites infected with EEE and their secretions or excretions. With animals other than rattites infected with EEE, gloves or double plastic bags should be used when handling dead animals. Recent evidence also supports the potential for WNV transmission from bird-to-bird.

E. Incubation Period

The incubation periods for some of the arboviral encephalitides are as follows. EEE: 3–10 days. WNV and California encephalitis: 5–15 days. Powassan encephalitis: 4–18 days. SLE: 4–21 days. VEE: 2–6 days. WEE: 5–10 days. LaCrosse encephalitis and Jamestown Canyon virus: 5–15 days.

F. Period of Communicability or Infectious Period

The arboviral encephalitides are not communicable from person-to-person.

G. Epidemiology

Signs of equine (horse) encephalitis were first noted in the eastern United States as early as 1831. Over one hundred years later, the etiologic agent EEE was recovered from a horse brain in 1933. The virus was first isolated from a human case in 1938 during an outbreak in southeastern Massachusetts. EEE is found in the eastern and north central regions of the US and adjacent regions of Canada, as well as in portions of Central and South America. The greatest risk of acquiring EEE is from late July through September (until the first frost). The risk is highest in southeastern New England, especially along the coastal regions. There have been about 80 cases of EEE reported in Massachusetts since 1938, and all but one case occurred east of Route 495. Since 1964, there have been 153 confirmed cases of EEE nationwide.

Before the fall of 1999, WNV had not been documented in the Western Hemisphere. WNV was first isolated in the West Nile Province of Uganda in 1937. The first epidemic was in Israel during the 1950s. WNV occurs naturally in Africa, India, Australia, the Middle East and Eastern Europe. In 1999, human cases of WNV were identified in New York City. By the end of October 1999, WNV had been confirmed in multiple native species of birds from New York City and areas within a 200-mile radius. As of this writing, birds from New York, Connecticut, New Jersey, Maryland, Rhode Island, New Hampshire, Pennsylvania and Massachusetts have been found infected with WNV. WNV has also been found to cause encephalitis in horses in New York, Massachusetts, Rhode Island, New Jersey and Connecticut.

Most cases of arboviral encephalitis in North America occur in the summer and early to mid-fall. The elderly are at greatest risk of encephalitis with WNV, SLE and EEE, while children under 15 years old are at greatest risk from LaCrosse virus infection. WEE is found in the western and central portions of the US, in Canada, and in parts of South America. SLE is found in most of the US, as well as in parts of Canada, the Caribbean Islands, and Central and South America. LaCrosse encephalitis is found in the eastern half of the US. Snowshoe hare encephalitis occurs in Canada, China and Russia. Powassan encephalitis occurs in Canada, the US and Russia. VEE is endemic in parts of South and Central America and the Caribbean.

2) REPORTING CRITERIA AND LABORATORY TESTING SERVICES

A. What to Report to the Massachusetts Department of Public Health

- Report any case of encephalitis diagnosed by a healthcare provider with or without laboratory results indicating the presence of a causative pathogen.

Note: For encephalitis caused by an organism that is otherwise reportable, such as *Listeria* sp., *Toxoplasma gondii*, measles virus, varicella virus, etc. or for non-arboviral encephalitis, please refer to Section 2A of the chapter specific to that organism or disease. Otherwise use the criteria above. See Section 3) C below for information on how to report a case.

B. Laboratory Testing Services Available

The Massachusetts State Laboratory Institute (SLI) is able to perform IgG and IgM EIA tests as well as cell culture and RT-PCR for eastern equine encephalitis virus and West Nile virus. Accurate information about date of collection, date of onset of symptoms, travel history, flavivirus vaccination and disease history are essential for test interpretation. For additional information on submitting samples or testing for other types of arboviral infection, contact the Viral Laboratory at (617) 983-6396 or (617) 983-6382.

3) DISEASE REPORTING AND CASE INVESTIGATION

A. Purpose of Surveillance and Reporting

- To identify locally acquired cases of EEE infection in humans to better understand the local epidemiology of EEE virus.
- To identify locally acquired cases of EEE infection in humans to help target mosquito control measures.
- To identify cases of other arboviral infections (*e.g.*, California encephalitis, St. Louis encephalitis) in Massachusetts residents or visitors to determine whether they are imported or locally acquired.
- To identify cases of WNV infection to understand the epidemiology of this emerging disease in our area.
- To provide residents of Massachusetts and travelers to the state with appropriate preventive health information.

B. Laboratory and Healthcare Provider Reporting Requirements

Please refer to the lists of reportable diseases (at the end of this manual's introductory section) for specific information. *Note:* Due to the rarity and potential severity of arboviral encephalitis, the Massachusetts Department of Public Health (MDPH) requests that information about any suspect or known case of arboviral encephalitis be **immediately reported** to the local board of health where diagnosed. If this is not possible, call the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850 (weekdays), or (617) 983-6200 (emergency number for nights/weekends). A case is defined by the reporting criteria in Section 2) A above.

C. Local Board of Health Responsibilities

1. **Reporting Requirements**

   MDPH regulations (*105 CMR 300.000*) stipulate that each local board of health (LBOH) must report the occurrence of any case of arboviral encephalitis, as defined by the reporting criteria in Section 2) A above. Please refer to the *Local Board of Health Reporting Timeline* (at the end of this manual's introductory section) for information on prioritization and timeliness requirements of reporting and case investigation.

2. **Case Investigation**

   a. **The most important thing a LBOH can do if it learns of a suspect or confirmed case of arboviral encephalitis is to call the MDPH immediately, any time of the day or night.** Daytime phone numbers of the Division of Epidemiology and Immunization are (617) 983-6800 and (888) 658-2850. The phone number for nights and weekends is (617) 983-6200.

b. Case investigation of arboviral encephalitis in Massachusetts residents will be directed by the MDPH Division of Epidemiology and Immunization. For non-arboviral cases of encephalitis, please refer to the chapter entitled "Encephalitis (Non-Arboviral)" or to the chapter specific to the causative organism, such as *Listeria* sp., *Toxoplasma gondii*, measles virus, or varicella virus.

c. The LBOH may be asked to assist in completing an official MDPH *Generic Disease Reporting Form* (in Appendix A) by interviewing the case and others who may be able to provide pertinent information. Most of the information required on the form can be obtained from the healthcare provider or the medical record. Use the following guidelines to assist you in completing the form:
   1) Record encephalitis as the disease being reported.
   2) Indicate the organism isolated/identified, if known.
   3) Indicate the type of specimen from which the virus was isolated/identified, if known.
   4) Accurately record the case's demographic information.
   5) Record the date of symptom onset, whether hospitalized and other associated dates. Other medical information can be recorded in the "Comments" section at the bottom of the page.
   6) Record the case's travel history: determine the date(s) and geographic area(s) traveled to by the case up to 30 days before onset. Questions about travel history are asked to identify where the patient may have become infected. This information can be recorded in the "Comments" section at the bottom of the form.
   7) Complete the "Import Status" section to indicate where the illness was acquired. If unsure, check "Unknown."
   8) Include any additional comments regarding the case.
   9) If you have made several attempts to obtain case information, but have been unsuccessful (*e.g.,* the case or healthcare provider does not return your calls or respond to a letter, or the case refuses to divulge information or is too ill to be interviewed), please fill out the form with as much information as you have gathered. Please note on the form the reason why it could not be filled out completely.

c. After completing the form, attach lab report(s) and fax or mail (in an envelope marked "Confidential") to the MDPH Division of Epidemiology and Immunization, Surveillance Program. The confidential fax number is (617) 983-6813. Call the Surveillance Program at (617) 983-6801 to confirm receipt of your fax. The mailing address is:

   MDPH, Division of Epidemiology and Immunization
   Surveillance Program, Room 241
   305 South Street
   Jamaica Plain, MA 02130

d. Institution of disease control measures is an integral part of case investigation. It is the LBOH responsibility to understand, and, if necessary, institute the control guidelines listed below in Section 4), Controlling Further Spread.

4) CONTROLLING FURTHER SPREAD

A. Isolation and Quarantine Requirements (*105 CMR 300.200*)

For most cases of encephalitis there are no isolation and quarantine requirements. However, for encephalitis caused by an organism that is otherwise reportable, please refer to the chapter of that specific organism or disease for the appropriate isolation and quarantine requirements.

B. Protection of Contacts of a Case

In most cases of encephalitis, there are no recommendations for protection of contacts of a case. There is no approved vaccine available, and transmission from person-to-person and animal-to-person (except from rattites) does not occur. Mosquitoes can be controlled by screening sickrooms, spraying with insecticides and using bed

nets. These measures can prevent transmission of arboviral encephalitides from cases to mosquitoes to contacts of cases.

Note: The mosquitoes that transmit EEE and WNV are found in Massachusetts. For encephalitis caused by an organism that is otherwise reportable, please refer to Section 4) B of that specific organism or disease.

C. Managing Special Situations

Locally Acquired Case
If you determine during the course of the investigation that a case does not have recent travel history to an endemic area or county, environmental measures such as investigating local areas visited by the case to locate the focus of infection and surveillance of other people for illness may be necessary. See next section below.

Reported Incidence Is Higher than Usual/Outbreak Suspected
If you suspect an outbreak, contact the epidemiologist on-call at the Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850. The situation may warrant an investigation of clustered cases or implementation of effective prevention and control measures (*e.g.*, spraying for mosquitoes). The Division can help determine a course of action to prevent further cases and can perform surveillance for cases across town lines and therefore be difficult to identify at a local level.

D. Preventive Measures

Environmental Measures
In Massachusetts, the MDPH Arboviral Surveillance Laboratory conducts environmental surveillance of mosquitoes in numerous sites throughout the state for WNV, EEE virus and Highlands J virus. (Highlands J virus is another mosquito-borne arbovirus which does not cause illness in humans but serves as a sentinel for EEE virus because it is usually detected several weeks prior to EEE virus.) Results of mosquito surveillance can be accessed on the MDPH website at <http://www.state.ma.us/dph>.

Decisions about the need for mosquito pesticide spraying are normally made by local cities and towns (based on mosquito habitat and density, surveillance for EEE or WNV virus in mosquitoes, numbers of cases in birds and other animals, and numbers of cases in humans).

Personal Preventive Measures/Education
People, particularly those living in or visiting high-risk areas, are encouraged to protect themselves from mosquito bites by the use of repellents and protective clothing. They should also stay indoors at dawn and dusk when mosquitoes are most active and use gloves when handling horses and birds that are sick with or have died from arboviral infection. Persons in the environment of rattites (emus, ostriches, rheas) infected with EEE should take strict precautions when handling sick or dead animals or their secretions/excretions.

Various public health fact sheets (*e.g.*, *Eastern Equine Encephalitis, West Nile Encephalitis, Insect Bites and Insect Repellents,* and *Steps You Can Take To Prevent West Nile Virus*) can be obtained from the Division of Epidemiology and Immunization or through the MDPH website at <http://www.state.ma.us/dph/>. Click on the "Publications" link and scroll down to the Fact Sheets section.

ADDITIONAL INFORMATION

The following is the formal Centers for Disease Control and Prevention (CDC) surveillance case definition for arboviral encephalitis. It is provided for your information only and should not affect the investigation or reporting of a case that fulfills the criteria in Section 2) A of this chapter. (CDC case definitions are used by the state health department and CDC to maintain uniform standards for national reporting.) For reporting a case to the MDPH always use the criteria outlined in Section 2) A.

Laboratory criteria for diagnosis

- Fourfold or greater change in serum antibody titer; or

- Isolation of virus from or demonstration of viral antigen or genomic sequences in tissue, blood, cerebrospinal fluid (CSF), or other body fluid; or
- Specific immunoglobulin M (IgM) antibody by enzyme immunoassay (EIA) antibody captured in CSF or serum. Serum IgM antibodies alone should be confirmed by demonstration of immunoglobulin G antibodies by another serologic assay (*e.g.*, neutralization or hemagglutination inhibition).

Case classification
Probable: a clinically compatible case occurring during a period when arbovirus transmission is likely, and with the following supportive serology: a stable (≤ twofold change) elevated antibody titer to an arbovirus (*e.g.*, ≥320 by hemagglutination inhibition, ≥128 by complement fixation, ≥256 by immunofluorescence, and ≥160 by neutralization, or ≥400 by enzyme immunoassay IgM).
Confirmed: a clinically compatible case that is laboratory confirmed.

Comment
The seasonality of arboviral transmission is variable and depends on the geographic location of exposure, the specific cycles of viral transmission, and local climatic conditions. Reporting should be etiology-specific (see below; the four encephalitides printed below in bold are nationally reportable to CDC):

- **St. Louis encephalitis**
- **Western equine encephalitis**
- **Eastern equine encephalitis**
- **California encephalitis serogroup** (includes infections from the following viruses: LaCrosse, Jamestown Canyon, Snowshoe Hare, Trivittatus, Keystone, and California encephalitis viruses)
- Powassan encephalitis
- Other CNS infections transmitted by mosquitoes, ticks, or midges (*e.g.*, Venezuelan equine encephalitis and Cache Valley encephalitis)

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